TITLE

DRIVE UNIT FOR AN ELEVATOR

BACKGROUND OF THE INVENTION

The present invention relates to a drive unit for an elevator comprising motors and a traction sheave wherein the traction sheave and the motors are supported on bearing end-plates arranged on a machine frame.

There is shown in the European patent application EP 0 565 893 a drive unit for elevators which, between two bearing end-plates, has a traction sheave and electric motors which can be mechanically coupled in series. The rigidly series-coupled external-rotor motors are synchronized by means of a multi-motor speed control. The traction sheave and the motors are supported on a rigid axle supported by the bearing end-plates.

A disadvantage of this known device is that the forces acting on the rigid axle are unfavorably distributed. The main forces emanating from the traction sheave must largely be absorbed by the bearing end-plate. Also, the series-coupled electric motors make large distances between bearing end-plates necessary.

SUMMARY OF THE INVENTION

The present invention concerns a compact elevator drive unit. The drive unit includes: a pair of spaced apart bearing end-plates mounted on a machine frame, each of the bearing end-plates retaining an associated bearing; a pair of electric motors, each of the motors being supported by an associated one of the bearing end-plates; a shaft having opposed free ends, the shaft being rotatably supported by the bearings, each of the free ends of the shaft being drivingly connected to an associated one of the motors; and a traction sheave supported by the shaft for rotation by the motors. A plurality of frequency converters is connected to the motors for operation in a master/slave mode.

The advantages achieved by the present invention are essentially that a drive unit with a short shaft and therefore a short overall length of the drive unit can be realized. It is also advantageous that the traction sheave is held in bearings at both ends and the electric motors can be arranged symmetrically relative to the traction sheave, which makes the drive unit usable in the highest performance segment.

DESCRIPTION OF THE DRAWINGS

The above, as well as other advantages of the present invention, will become readily apparent to those skilled in the art from the following detailed description of a preferred embodiment when considered in the light of the accompanying drawings in which:

Fig. 1 is a view of a drive unit according to the present invention;

Fig. 2 is a cross-sectional view taken through the drive unit shown in Fig. 1 along its shaft; and

Figs. 3 and 4 are schematic diagrams of an electric power supply utilized with the drive unit shown in Figs. 1 and 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows a completely assembled drive unit **1**, consisting essentially of a machine frame **2** on which a first bearing end-plate **3** and a second bearing end-plate **4** are arranged. Also arranged on the machine frame **2** is a secondary-sheave mounting **5** with a secondary sheave **6**. The bearing end-plates **3, 4** support a traction sheave **7** over which ropes **8** are guided, the ropes **8** being also guided over the secondary sheave **6**. A distance **SA** is required between the rope-fall of an elevator car (not shown) and a counterweight (not shown).

Arranged on the first bearing end-plate **3** is a first motor **9**, and on the second bearing end-plate **4** a second motor **10**. Each of the motors **9, 10** is provided with a terminal box **11** and with fans **12.1, 12.2** (Fig. 2). The traction sheave **7** has on each side a brake disk **13** on which two disk brakes **14** act.

Fig. 2 shows a cross-section through the drive unit **1**. The traction sheave **7** is supported by a shaft **15**, the shaft **15** being held rotatably in a first bearing **16** of the first bearing end-plate **3** and in a second bearing **17** of the second bearing end-plate **4**. A first free-end of the shaft **15** is indicated with **15.1**, and a second free-end of the shaft **15** is indicated with **15.2**. Mounted on the first free-end **15.1** of the shaft **15** is a first rotor **9.1** of the first motor **9**. Arranged on the first bearing end-plate **3** by means of a first cage-housing **9.3** is a first stator **9.2**. Similarly, the second free-end **15.2** mounts a second rotor **10.1**, and the second bearing end-plate **4** has arranged thereon a second stator **10.2**

and a second cage-housing **10.3** of the second motor **10**. A tachogenerator **18** is coupled with the shaft **15** and is provided to register the rotational speed of the shaft.

Figs. 3 and 4 show an electric power supply for the drive unit **1**, more specifically the motors **9, 10**. The motors **9, 10** are of three-phase construction, each motor having a first winding-set **W1** and second winding-set **W2**, the windings of one winding-set being mechanically connected in parallel with the corresponding windings of the other winding-set. The first winding-set **W1** of the motor **9** is connected to the output of a first frequency converter **FU1**. The second winding-set **W2** of the motor **9** is connected to the output of a second frequency converter **FU2**.

The first winding-set **W1** of the motor **10** is connected to the output of a third frequency converter **FU3**. The second winding-set **W2** of the motor **10** is connected to the output of a fourth frequency converter **FU4**. The winding-ends at one end of each winding-set **W1, W2** are connected in a star formation. The system requires the outputs of the frequency converters **FU1, FU2, FU3, FU4** to be connected together in an electrically isolated manner, which is possible by means of several winding-sets **W1, W2** of the motors **9, 10** which are to be supplied with electric power provided that the motors **9, 10** are rigidly coupled by means of the shaft **15**.

The frequency converter **FU1** is determinant for the other frequency converters **FU2, FU3, FU4**, the frequency converters operating in master/slave mode. The frequency converter **FU1** determines based on an actual value of the rotational speed $\mathbf{V_{ACT}}$ of the tachogenerator **18**, and based on the reference value of the rotational speed $\mathbf{V_{REF}}$ of an elevator control (CONTROL), the references for the inverter regulation. The frequency converter **FU1** also produces the references for the converter regulation. A converter (CONVERTER) is connected to a power supply (POWER SUPPLY) and, depending on the converter regulation, generates the voltage of a DC link **DC** to which an inverter (INVERTER) is connected. An actual value of the rotational speed $\mathbf{V_{ACT}}$ and a reference value of the rotational speed $\mathbf{V_{REF}}$ are supplied to a rotational-speed regulator (ROTATIONAL SPEED REGULATOR) which determines a reference value for the current $\mathbf{i_{REF}}$ of the motors **9, 10**. The current of the three-phase winding-sets **W1, W2** is registered for each phase and fed as an actual current value $\mathbf{I_{ACT}}$ to a current regulator (CURRENT REGULATOR), which generates from the reference value of the current (portion of the reference value of the current $\mathbf{i_{REF}}$) and an actual value of the current $\mathbf{I_{ACT}}$

regulator signals (PWMM) for the switch of the inverter (INVERTER) which is connected to the voltage of the DC link **DC**. With regard to structure and function, the current regulator (CURRENT REGULATOR) and the inverter (INVERTER) of the other frequency converters **FU2, FU3, FU4** are comparable to the master frequency converter **FU1**. The specification of the amplitude of the reference value of current for the current regulator (CURRENT REGULATOR) of the frequency converters **FU2, FU3, FU4** takes place via a bidirectional bus (BUS). All other communication between the frequency converters **FU1, FU2, FU3, FU4** (error handling, internal monitoring, identification of the frequency converters, etc.) also takes place via this bus (BUS).

The master frequency converter **FU1** determines by means of the rotational-speed regulator (ROTATIONAL SPEED REGULATOR) the total current i_{REF} which is distributed to all of the frequency converters **FU1, FU2, FU3, FU4**. The underlying current regulator (CURRENT REGULATOR) operates on, for example, the principle of vector regulation, transmission of the transformation angle of the reference value of the current from the master frequency converter **FU1** to the slave frequency converter **FU2, FU3, FU4** taking place via the unidirectional bus (BUS).

The voltage of the DC link **DC** is generated by the converter (CONVERTER), which is connected to the three-phase power supply (POWER SUPPLY). The switch of the converter (CONVERTER) is controlled by means of control signals (PWML) which are generated by the converter regulator (DC REGULATOR). With regard to structure and function, the converter regulator (DC REGULATOR) and the converter (CONVERTER) of the other frequency converters **FU2, FU3, FU4** are comparable to the master frequency converter **FU1**, synchronization of the converter (CONVERTER) of the frequency converters **FU2, FU3, FU4** taking place by means of a timing signal of the frequency converter **FU1** via the unidirectional bus **SSL**.

In accordance with the provisions of the patent statutes, the present invention has been described in what is considered to represent its preferred embodiment. However, it should be noted that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.